A CONVENIENT THERMOREGULATOR

HEINRICH HASSELBRING

(WITH TWO FIGURES)

A convenient form of thermoregulator which has now been in use in several laboratories of the Bureau of Plant Industry, United States Department of Agriculture, for nearly ten years is shown in fig. 1. On account of its compactness and its adaptability to constant temperature baths and chambers of various kinds, where extreme sensitiveness is required, it may perhaps be worth while to give a brief description of the instrument and its installation in order to make it more generally available.

The instrument consists of a thermometer tube about 30 cm. long, the upper end of which is bent over and enlarged into a bulb to serve as a reservoir for excess mercury. The thermometer bulb at the bottom should be about 7 or 8 cm. long. Platinum contacts leading to the binding posts clamped on the thermometer are sealed into the capillary at *A* and *B*. At a point (*C*) some distance from the upper contact a slight constriction is formed in the thermometer capillary. This point may be marked on the tube. For ordinary incubator temperatures the constriction should be about 2.5 cm. above the upper contact; for temperatures around zero it should be 5 or 6 cm. above.

Experience with many of these instruments has shown that in their manufacture the observance of several points is absolutely essential. (1) The space above the mercury must be entirely free from gas. The presence of a trace of gas prevents the union of mercury from the reservoir with that of the capillary and makes the instrument entirely useless. (2) The platinum wires must project far enough into the capillary to make contact with the mercury, but not so far that they interfere with the motion of the mercury column. If the wire projects too far into the capillary

the mercury will hang on the wire, and regulation thereby becomes impossible. The seal must be gas-tight. (3) The constriction of the capillary at *C* must be narrow enough so that a short section of the mercury column above will not slide down past the constriction even with slight jarring. It must be possible, however, to shake mercury down past the constriction. (4) The band holding the upper contact wire should not cover the contact point itself, otherwise adjustment is difficult.

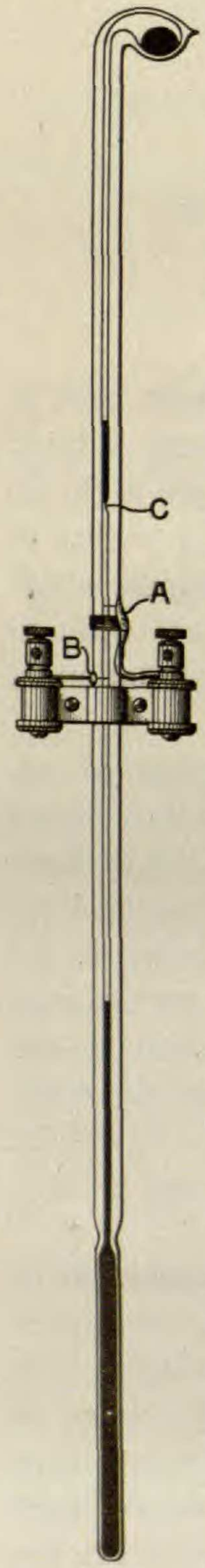

FIG. 1

To adjust the instrument for a given temperature an excess of mercury is shaken down below the constriction to unite with the column in the capillary. The remainder of the mercury above the constriction is allowed to flow, with gentle tapping or shaking, if necessary, into the upper bulb, the thermometer being inclined during the process. The constriction should be narrow enough to prevent the mercury below from flowing past it. The bulb of the regulator is now plunged into a large beaker of water kept exactly at the temperature for which the regulator is to be set. The mercury column will stand a little above the upper contact, since an excess of mercury was first shaken down past the constriction. The length of the mercury column above the contact is noted, and a section of nearly the same length is forced above the constriction by carefully lowering the bulb into another vessel of water kept at a sufficiently higher temperature. The bulb is then replaced in the first vessel and the process repeated. Finally, only single globules are forced past the constriction until the end of the column stands exactly at the upper contact wire, when the bulb is kept in water at the desired temperature. If the constriction has been properly made, the short piece of mercury column above it may be left in place.

This regulator is designed to actuate a telegraphic relay which interrupts the heating current. The installation shown in fig. 2

requires but little explanation. The current passing through the regulator and actuating the relay may be taken either from a line circuit or from a constant circuit battery. In either case the current should be so reduced by means of resistance and by reduction of the voltage that the current passing through the regulator does not exceed 0.015 of an ampere. Larger currents damage the regulator. Various types of heaters may be used, but in general the current to be interrupted by the relay should be as small as possible. Where high temperatures are to be maintained, it is usually best to have an auxiliary heater which by running con-

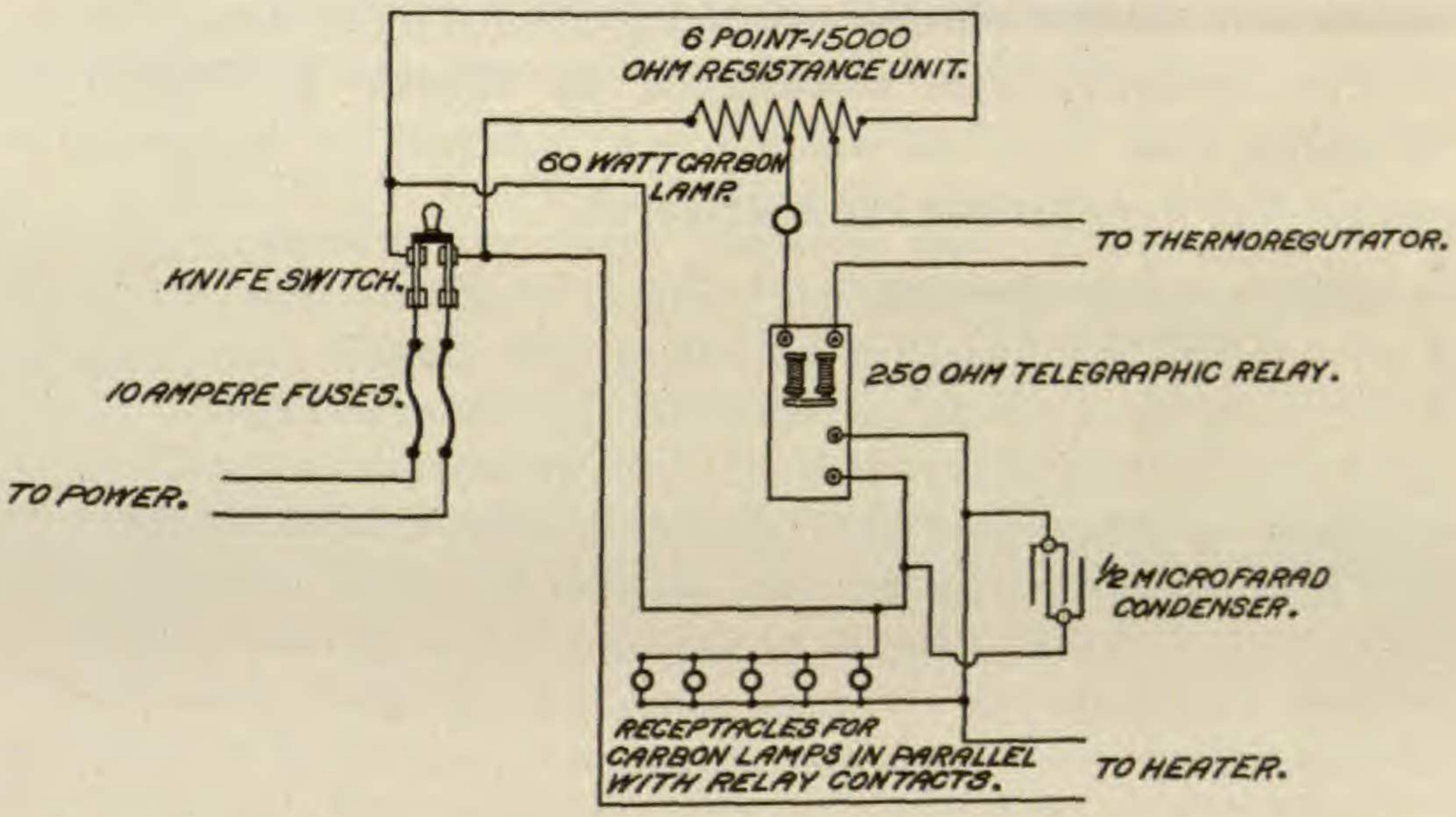

FIG. 2

stantly maintains the temperature nearly at the desired point. The deficiency is controlled by a heater of smaller capacity regulated by the relay. If only one heater is employed, a large portion of the current may be made to flow continuously by inserting one or a number of carbon lamps in the circuit in parallel with the relay. The sparking at the relay contacts is thus greatly reduced. It is scarcely necessary to state that the relay magnets, armature spring, and contact points of the relay should be adjusted very carefully. When all adjustments of the installation are perfect, there is practically no spark at the relay contacts when the heating current is interrupted, and a barely audible click of the armature. With proper installation, ordinary telegraphic relays of 250 ohms' resistance will break a current of 2 amperes with practically no spark at

the contacts. For larger currents it is better to use some form of solenoid control switch actuated by the relay.

The installation shown in fig. 2 is adapted for a direct current circuit. In this case the current for the relay magnets is taken from the line as shown. If alternating current only is available, the current for actuating the relay should be supplied by a suitable constant circuit battery. Dry cells may be used if the current is on only for comparatively short intervals. In either case the current should not exceed 0.015 of an ampere. If an alternating current is used in the heating circuit, the condenser is not necessary, the reduction of the spark in that case being effected by the lamps alone.

The regulators were constructed by HENRY J. GREEN, of Brooklyn, New York, to whom I am indebted for interest and cooperation in perfecting the instrument.

BUREAU OF PLANT INDUSTRY
WASHINGTON, D.C.